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# Working Conditions and Product Quality: Evidence from Carpet Industry in Pakistan, India, and Nepal

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# Working Conditions and Product Quality: Evidence from Carpet Industry in Pakistan, India, and Nepal

## **Abstract**

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## **Keywords**

product quality, working conditions, carpet industry, Nepal, India, Pakistan

## **Comments**

### **Suggested Citation**

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# **Working Conditions and Product Quality: Evidence from Carpet Industry in Pakistan, India, and Nepal (DOLB119K32541)**

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Contents:  
Final Project Report

## Executive Summary

US trade agreements and preference programs require adherence to internationally recognized labor rights, and substantial policy attention is devoted to promoting improved working conditions in US trading partners. Many observers have noticed that better quality products tend to come from establishments with nicer working conditions. These anecdotes have raised hope of a virtuous circle where improvements in working conditions are self-sustaining and lead to improvements in product quality.

This study considers the relationship between product quality and working conditions in the handmade, export-oriented carpet industry in India, Nepal, and Pakistan. By focusing on a specific sector, we directly observe detailed, meaningful measures of product quality that are rare in the existing literature. Our focus on the Indian subcontinent is driven by an unusual dataset with these better quality measures and detailed data describing working conditions.

The most common measure of working conditions in the current literature is the unit wage (total labor bill divided by total workers). International labor standards emphasize many aspects of the work environment beyond the wage. We find little relationship between other core labor standards and unit wages. Unit wages are only one aspect of working conditions, and findings on unit wages cannot be assumed to generalize to other working conditions.

Unit product prices (total revenue divided by total sales) are the most prevalent measure of product quality. We observe that product quality is multi-dimensional. In addition to unit prices, we observe the actual price of the most recently completed carpet, its size, and its weight. These different aspects of product quality are not perfectly correlated. Findings on how one type of working condition impacts one aspect of product quality may not generalize to all aspects of product quality. We also raise concerns about the use of unit prices as a measure of quality, because unit prices can be driven by other firm attributes correlated with the work environment.

In considering the link between 14 different aspects of working conditions and 5 different product quality related outcomes, we illustrate potential pitfalls from relying on bivariate relationships and anecdotal evidence in assessing the causal link between working conditions and product quality. Better working conditions are associated with better quality among most dimensions of quality. However, these associations appear driven by establishment characteristics that are correlated with both the work environment and aspects of product quality.

The improvement of working conditions is a worthy, important goal in itself, but we observe little to suggest that improvements in working conditions can be self-sustaining because of improvements in product quality. The strongest evidence herein of an association between product quality and working conditions comes from compensation. It could be that improvements in compensation become self-sustaining because of improvements in product quality, but future research, experimentally varying aspects of the compensation package, would be necessary to identify whether and why there is a causal link. Based on the findings of this study alone, we see little reason to consider product quality as ILAB works towards its goals related to improving working conditions.

## 1. Introduction

Increases in globalization and advances in technology have enabled firms from developing countries to reach export markets in high-income countries. The increased presence of these firms in poor countries has led to a heated debate on their impact on wages and working conditions in the developing world (see Goldberg and Pavcnik (2007) for a survey). Some argue that globalization encourages firms in developing countries to pay lower wages and offer worse working conditions in order to produce products at the lowest cost.<sup>1</sup> Most of this literature assumes that firms produce the same quality products for domestic and export markets. Several recent large-scale, nationally representative firm-level studies have shown that firms from developing countries need to produce higher quality products for the export markets than for domestic markets to appeal to consumers in high-income countries (Verhoogen (2008), Iacovone and Javorcik (2010a, 2010b)). The literature has subsequently developed models, where production of high quality products requires that firms pay higher wages to workers to ensure high quality production for export markets (Verhoogen (2008) and Kugler and Verhoogen (2012), Harrison, McLaren, McMillan (2011)). This literature finds empirical support consistent with the idea that production of high quality exports improves wages of workers employed in firms that are directly engaged in exporting.<sup>2</sup>

This project builds on and contributes to this literature with empirical research that examines the relationship between working conditions and product quality in the export oriented, handmade carpet industry in India, Nepal, and Pakistan. By focusing on a narrow industry with a product whose quality is easily measured and comparable across manufacturing environments,

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<sup>1</sup> Most existing studies find that multinationals and exporters actually pay higher wages than domestic firms (see survey by Harrison and Rodriguez Clare (2010)). Nonetheless, studies such as Harrison and Scorse (2010) suggest that exporters and multinationals increase worker wages when faced with pressure from anti-sweat shop campaigns, suggesting that these firms have potential to shift some additional profits to workers.

<sup>2</sup> See surveys by Harrison, McLaren, McMillan (2011) and Pavcnik (2011).

we can make considerable advances over the existing literature on product quality and working conditions. We consider definitions and dimensions of product quality and working conditions that are usually not available to researchers in standard firm-level data sets. In this study, we study whether better working conditions are associated with higher product quality and what aspects of working conditions are associated with different understandings of product quality. The richness of our data and the measurability of differences in products across space allow us to examine the underlying mechanisms that drive the relationships between working conditions and product quality that we identify with a level of detail not previously available in this literature. We argue that most of the association between product quality measures and working conditions in our data is spurious, driven by carpet establishment characteristics associated with both product quality and working conditions measures.

This paper proceeds as follows. In section 2, we review the existing literature. In section 3, we discuss the data. Section 4 provides a descriptive summary of working conditions in the handmade carpet industry and discusses different dimensions of product quality in handmade carpets. Section 5 lays out our empirical methodology that link working conditions to product quality. Section 6 presents the results. Section 7 concludes.

## **2. Literature Review**

This literature review is organized as follows. The review first discusses the commonly used measures of product quality and working conditions. The strengths and shortcomings of these measures are discussed in light of the possible channels through which working conditions could be correlated with product quality, both causal channels and sources of omitted variable bias.<sup>3</sup>

The review then discusses the small literature on the relationship between working conditions

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<sup>3</sup>Given the topic of our project, we limit our discussion of these two concepts mainly to papers that ultimately focus on the relationship between product quality and working conditions.

and product quality. We focus on the causal channels for the link between the two, and important identification assumptions in the empirical work that are required to consider a causal connection between product quality and working conditions. The review concludes with a brief discussion of the contribution of the current study to this literature.

## **2. 1. Measuring Working Conditions and Product Quality**

Concepts like "product quality" and "work conditions" are multidimensional, difficult to define, and often not directly measured in standard nationally representative data sources on firms and workers. As a result, most studies on the relationship between working conditions and product quality focus on a handful of readily available measures. We review these measures, discuss their strengths and shortcoming, and suggest how our study contributes to a better understanding of measuring working conditions and product quality.

### **2.1.1. Working Conditions**

The most studied working conditions are based on worker outcomes such as wages and number of weekly hours that a worker spends working.<sup>4</sup> The advantage of these measures is that they are easily obtained from publicly available data sources such as labor force surveys and firm-level data for a large set of countries and clearly describe an important component of the employer-worker relationship. These measures are also readily comparable across workers and firms.

However, the use of worker wages and hours worked as measures of working conditions needs to take into account worker heterogeneity and that they are outcomes of a workers' decision rather than an exogenous workplace characteristics. In particular, one needs to be cautious about interpreting differences in wages and hours worked across workers or firms as

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<sup>4</sup> See, Brown and Medoff (1989), Verhoogen (2008), Abowd, Kramarz, Margolis (1994)), and Goldberg and Pavcnik (2003)) for examples that are most relevant for our topics.



simply reflecting differences in working conditions. For example, worker wages in part reflect the marginal productivity of a worker. Lower wages for a worker in one firm compared to a worker in a different firm might reflect lower educational achievement, experience, or ability of the first worker rather than anything about her workplace. Likewise, differences in hours worked might also be driven by workers' preferences rather than hours imposed on the worker by the employer. Longer hours worked need not imply worse working conditions; some workers might choose to work longer hours. As a result, it is crucial for studies that measure working conditions with workers' outcome variables to control for differences in worker demographic and human capital characteristics.<sup>5</sup> Furthermore, longer working hours might impair workers' performance due to physical and mental limits of an average person. In fact, several studies find negative correlation between long working hours and various dimensions of performance.<sup>6</sup>

The focus on wages and hours worked alone abstract from other aspects of working environment that might influence workers' wellbeing, productivity, and ability to produce quality products. More detailed measures of working conditions, which include physical workplace facilities, worker safety, flexibility of schedule, benefits, and measures of industrial relations are less commonly available in nationally representative labor surveys.<sup>7</sup> Consequently,

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<sup>5</sup> Brown and Medoff (1989), Frias, Kaplan, and Verhoogen (2009), Verhoogen (2008), Abowd, Kramarz, Margolis (1994), and Goldberg and Pavcnik (2003) all control for a wide range of worker demographic and human capital characteristics as well as differences in regional labor markets. However, many studies abstract from this important interpretational issue.

<sup>6</sup>For example, Caruso (2006) surveys research on the consequences of long work hours. Several studies suggest that long working are associated with deterioration in various dimension of performance, increased errors, and poor performance on attention and vigilance test in a wide range of industries. For example, Arnedt. et. al. (2005) find that medical residents working 80 hour weeks exhibit impaired performance on attention and vigilance tests. Procter et. al. (1996) document poor performance on cognitive function tests and diminished capacity to plan and prioritize among auto workers working longer shifts and overtime. Other studies document deterioration in alertness (MacDonald and Bendak (2000), Fischer et. al. (2000)) and increased task errors among power plant workers (Mitchell and Williamson (2000)). Thomas and Raynar (1997) find decreased productivity of workers due to mistakes and need to rework at construction projects with 50 to 60 hour work weeks.

<sup>7</sup> For example, a special module of the 1994 June wave of the Colombian National Household survey interviewed workers about the Quality of Employment. This survey elicited qualitative responses about job characteristics,

researchers design specific, smaller scale survey to measure more nuanced aspects of working conditions.<sup>8</sup> The definition of working conditions vary with the focus of the study and include variables that capture the industrial relation system (Katz, Kochan, and Weber (1985)), physical facilities and workplace safety (Emmelhainz and Adams (1999), Eklund (1995), and the ability of workers to dictate own shift and overtime schedule (Brown and Madoff (1989)). Some of the above mentioned working conditions capture a characteristic of a firm rather than an employee outcome. Because workers might still select an employer depending on their own level of education, ability, preferences over schedule flexibility, one needs to take this underlying worker heterogeneity into account when interpreting the variation if workplace characteristics across firms.<sup>9</sup>

The above discussion highlights the importance of considering differences in the composition of the workers across establishments when using various worker outcomes and/or firm workplace characteristics as measures of working conditions. In addition, the rarity of studies that use detailed measures of working conditions suggests that such measures are difficult and expensive to collect. The existing studies often rely on very small, non-representative samples. As a result, it is important to assess whether these more detailed measures of working conditions provide important additional information about how workplace characteristics affect workers' wellbeing and/or productivity at his or her job and ability to produce quality products that is not captured in the hours worked and wages. Given the scarcity of research on working

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employee relations, and workplace conditions, as well as information about the benefits offered by the employers and the availability of job training (see Goldberg and Pavcnik (2003)).

<sup>8</sup>See Katz, Kochan and Weber (1985), Emmelhainz and Adams (1999), Eklund (1995)) as examples. While the surveys collect detailed information on working conditions, they often rely on very samples of firms, at times not exceeding 10 firms.

<sup>9</sup>Very few studies do so. As examples, see Brown and Madoff (1989), Goldberg and Pavcnik (2003), Verhoogen (2008), Frias, Kaplan, and Verhoogen (2009).

conditions other than hours worked and wages and product quality, working conditions in the remainder of the review mainly include hours worked and wages.

### **2.1.2 Product Quality**

Product quality is difficult to measure, especially in surveys that cover economy-wide sectors. As a result, most economy-wide studies that use nationally representative firm-level data or product-level data do not use a direct measure of product quality. Quality is either measured by a proxy or is imputed, with some additional assumptions about the underlying product demand function, using information about a product's market share and price. The advantage of this approach is that quality can be quantified for a large set of industries, products, and countries. The disadvantage is that the actual quality is not directly observed. The above measures might not capture the nuances of how quality is defined in a particular industry.

Most studies proxy for product quality with unit values (i.e. revenues/quantity sold) which are interpreted as product prices.<sup>10</sup> These studies assume that higher prices reflect higher quality. Higher prices for higher quality products could reflect greater marginal costs of production. It is more expensive to produce a better product. Alternatively, higher price might be used as a signal for higher quality when there are informational asymmetries among the consumers (see Wolinsky (1983)).

While higher unit values might signal higher quality, higher prices might also reflect market power and/or differences in consumer preferences. Quality measures imputed from a demand system overcome this potential shortcoming of using product prices as proxies for quality. Recent studies (Khandelwal (2010), Hallak and Schott (2011)) develop and compute a measure of product quality by using readily available product-level trade or production data on

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<sup>10</sup> See Abowd, Kramarz, Moreau (1996), Schott (2004), Hallak (2006), Kugler and Verhoogen (2012), Hallak and Sivadasaan (2010), Iacovone and Javorcik (2008, 2010), Johnson (2012), and Baldwin and Harrigan (2011)).

product market share and price, combined with an assumption about the demand system derived from a consumer utility maximization.<sup>11</sup> Product market share depends on product price and other product attributes, including product quality. In the demand estimation, quality is modeled as (to the econometrician) unobserved characteristic. The idea is that conditional on prices, higher market share of a product reflect higher quality. A measure of product quality is obtained as the difference between the actual product market share and the market share predicted from the demand system based on observed product prices and other observable product characteristics.

This approach to measuring product quality yields several insights. First, Khandelwal (2010) shows that unit prices are better correlated with quality in industries with a greater scope for quality differentiation. The correlation between prices and quality is low in industries where product differentiation is mainly horizontal in nature (i.e. there is little quality or vertical differentiation).<sup>12</sup> Second, product quality measures suggest that products and industries differ substantially in the scope to differentiate on quality (Khandelwal (2010)), with products in industries such as instruments and electronic equipment exhibiting substantial quality differentiation, while industries such as fabricated metals exhibiting little quality variation across products. Quality differentiation appears more pronounced in more capital and R&D intensive industries. Third, there are systematic differences across countries in the presence of higher quality products, with countries with higher GDP per capita and more university-educated labor force tending to produce higher quality products. These correlations could imply that the

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<sup>11</sup> In particular, Khandelwal (2010) infers a measure of quality from a structural model of nested logit demand using information for market shares and prices of the same product. A related approach has been followed by Hallak and Schott (2011).

<sup>12</sup>This finding is intuitive. Prices will likely reflect tastes rather than quality in industries with horizontally differentiated products.

underlying economic environment affects the ability of countries to produce high-quality products.

A third approach to measuring quality is to use observable measures of product quality that are established among the consumers and producers in a given industry. For example, several recent studies measure quality with information on whether a firm has an ISO 9000 certification (see for example, Verhoogen (2008), Karlton, Axelsson, Eklund (1998)). Verhoogen (2008) suggests that many managers view products produced in firms that undergo and pass the costly ISO 9000 certification process, to be of higher quality and that firms choose to be certified to signal higher quality product.<sup>13</sup> Alternatively, industry-specific studies use measures of quality that reflect opinions of the industry experts. For example, Crozet, Head, Mayer (2007) relies on wine producer quality rankings from industry publications. Or, quality is measured directly with observable product attributes. For example in the carpet industry, knot density and weight of a carpet are well-established measures of product quality. Higher quality carpets have more knots per square inch and are heavier. Third, some studies measure product quality using quality assessments of a product based on inspection of deficiencies of the product found during the internal inspection after production. Lower quality products have more faults and demerits found during the inspection (Katz, Kochan, Weber (1985), or are defined as products with more serious safety deficiencies (Eklund (1995)).<sup>14</sup> This approach to measuring quality provides does not require strong modeling assumptions and better captures the nuances of quality in a given industry. However, it can only be used in studies that focus on an industry, where detailed measures of quality can be meaningfully defined.

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<sup>13</sup> See Verhoogen (2008) for details about this certification. Many conventional datasets do not include the information on the certification status. But this data is available for Mexico and for some countries in the firm-level World Bank Enterprise Surveys.

<sup>14</sup> Alternatively, product quality is based on the assessment of the plant manager obtained from subjective qualitative survey questions (Cooke (1992)).

The above discussion clearly shows the challenges of measuring product quality. An important advantage of our study is that we focus on a narrow industry with a product whose quality is easily measured and comparable across manufacturing environments across countries. We examine definitions and dimensions of product quality conditions that are usually not available to researchers in standard firm-level or worker-level data sets. This helps us assess whether more detailed measures of product quality available in our data are highly correlated with more commonly available measures of product quality such as unit values.

## **2.2 The relationship between working conditions and product quality**

Very few existing studies directly examine the relationship between working conditions and product quality. Most of the literature is descriptive in nature, offers mixed findings on the relationship, and the findings are difficult to interpret in light of the problems raised with the various measures of working conditions and product quality discussed in section 1. The working conditions in this section refer to hours worked and wages because these are the two measures commonly used in existing work.<sup>15</sup> This section first highlights the common problems faced by the existing literature and then discusses the studies that have provided key contributions toward resolving some of these methodological challenges.

The majority of the existing literature provides little guidance for the understanding of the relationship between working conditions and product quality in a poor country setting. First, most of this literature examines the issue in a developed country context.<sup>16</sup> Second, most of the studies have only limited simultaneous access to good measures of product quality and working conditions. Third, with the exception of the few studies noted below, most of this literature does not provide a further analysis of the mechanisms underlying the relationship. As a result, the

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<sup>15</sup>We explicitly note cases in the text where we focus on other aspects of working conditions.

<sup>16</sup>Verhoogen (2008) and Kugler and Verhoogen (2012) are exceptions and focus on Mexico and Columbia, respectively.

relationship between the mechanisms underlying the relationship between working conditions (in this section mainly defined as hours worked and wages due to data used in reviewed literature) and product quality continues not to be sufficiently understood.<sup>17</sup>

Let us first illustrate the potential issues that arise in interpreting the results from studies of working conditions and product quality. Let us suppose that the econometric analysis suggests a positive association between better working conditions and product quality. This positive relationship cannot be necessarily interpreted as suggesting that better working conditions lead to production of higher quality products. This positive relationship could reflect that establishments with better working conditions attract better workers and better workers produce high quality products. One can directly examine this first mechanism by controlling for a wide range of observable worker characteristics if such characteristics are available in the data. If the positive basic relationship reflects sorting of better workers to establishments with better working conditions, this augmented specification should reduce the correlation toward zero. Likewise, managers with skills that lead to high product quality might run establishments with better workplace characteristics. One needs to take into account these underlying differences in managerial characteristics across the firms. If the correlation between working condition and product quality continues to be positive and statistically significant after we control for a wide range of worker and establishment characteristics have been taken into account, the evidence would be consistent with the idea that better working conditions induce workers to be more productive and produce higher quality products. Finally, studies that have panel data can further examine the robustness of this explanation by estimating empirical specifications using the panel

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<sup>17</sup> Abowd, Kramarz, Moreau (1996), Brown and Medoff (1989), Verhoogen (2008), Kugler and Verhoogen (2012), and Frias, Kaplan, and Verhoogen (2010) are exceptions. These studies conduct careful econometric analysis that rules out various spurious correlations between product quality and working conditions. We review the most relevant of these studies below.

dimension of establishment-level data and including establishment fixed effects, which will control for unobserved time-invariant establishment characteristics.

With these issues in mind, we next focus on the existing studies of working conditions and product quality that plausibly identify the causal relationship between working conditions and product quality. Some of the recent literature has examined the relationship between working conditions and product quality in the context of decisions of firms in less developing countries to enter export markets. Increases in globalization and advances in technology have enabled firms from developing countries to reach export markets in high-income countries. The increased presence of these firms in poor countries has led to a heated debate on their impact on wages and working conditions in the developing world (see Goldberg and Pavcnik (2007) and Harrison, McLaren, and McMillan (2011) for surveys). Some argue that globalization encourages firms in developing countries to pay lower wages and offer worse working conditions in order to produce products at the lowest cost.<sup>18</sup> Most of this literature assumes that firms produce the same quality products for domestic and export markets. However, several recent large-scale, nationally representative firm-level studies have shown that firms from developing countries need to produce higher quality products for the export markets than for domestic markets to appeal to consumers in high-income countries (Brooks (2006), Verhoogen (2008), Iacovone and Javorcik (2010a, 2010b)).

The literature has subsequently developed models where production of high quality products requires that firms pay higher wages to workers to ensure high quality production for export markets (Verhoogen (2008) and Kugler and Verhoogen (2012)). This literature finds

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<sup>18</sup> Most existing studies find that multinationals and exporters actually pay higher wages than domestic firms (see survey by Harrison and Rodriguez Clare (2010)). Nonetheless, studies such as Harrison and Scorse (2010) suggest that exporters and multinationals increase worker wages when faced with pressure from anti-sweat shop campaigns, suggesting that these firms have potential to shift some additional profits to workers.



empirical support consistent with the idea that production of high quality exports improves wages of workers employed in firms that are directly engaged in exporting. In Verhoogen (2008), firms within an industry are heterogeneous and face a fixed cost of exporting, only the most productive firms enter the export market and upgrade quality of their products. However, production of higher quality requires additional worker effort and firms pay workers efficiency wages to exert this effort. This, in turn, increases wages of workers in more productive firms relative to wages of those employed in less productive establishments, leading to growing wage inequality. The authors in fact find that expanded exporting opportunities of high quality products are associated with increased wages of workers in firms that take advantage of new exporting opportunities.<sup>19</sup> Frias, Kaplan, and Verhoogen (2010) find further confirmation of this relationship using matched employee-employer data from Mexico.<sup>20</sup>

The above studies assume that productivity and worker quality are complementary in producing high quality output. However, this assumption is difficult to confirm empirically because the standard firm-level datasets usually lack information on quality of inputs and quality of products at the firm level. Kugler and Verhoogen (2012) use a unique firm level panel data from Colombia that includes detailed information on the composition of products each firm

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<sup>19</sup> Normally, exporting and wage determination are highly correlated, and nearly impossible to disentangle in a statistical sense. Verhoogen (2008) identifies the effect by noting that initially more productive firms were differentially more likely to export in response to Mexico's unanticipated exchange rate shock in 1994. The identification relies on the interaction of exchange rate with pre-shock firm characteristics in a triple differences framework. The results support the hypothesis that increased export market access led to growing wage inequality in Mexico, increasing relative wages of workers (and especially white collar workers) in initially more productive plants relative to wages of workers in firms with low productivity. Verhoogen also finds that inherently more productive firms were more likely to respond to the exchange rate shock by upgrading quality of their products (as measured by an international quality standard (ISO 9000). For further discussion, see surveys by Harrison, McLaren, McMillan (2011) and Pavcnik (2011).

<sup>20</sup> They show that only about a third of the exporter wage premia can be attributed to worker characteristics, while the rest owes to plant-specific effects. Moreover, the observed increases in wages in exporting firms relative to non-traded firms after increased export opportunities are not driven by sorting of better workers to exporting firms. This suggests that responses of wages to new exporting opportunities are not driven by models that suggest sorting of workers across firms, but are more in line with models of rent sharing or models of wage determination that do not rely on neoclassical assumptions.

produces and reports prices and qualities of each product produced. It provides an excellent setting to evaluate the quality-complementarity. The authors show that larger firms charge higher prices for products (perhaps reflecting higher quality) and that larger firms average higher input prices.<sup>21</sup> These positive correlations are stronger in industries with greater scope for quality differentiation as measured by R&D intensity and spending on advertising.<sup>22</sup> This positive relationship between better working conditions and product quality from studies that rely on rigorous empirical methodology is in line with evidence from several case studies that study the link between better working conditions, management style, and product quality.<sup>23</sup>

In sum, the small existing literature suggest that a) production of higher quality products requires better production inputs, including better compensated workers and b) exogenous increases in demand for higher quality products lead to increased earnings of observationally equivalent workers in firms that produce exports. These findings are based on wages and unit values as measures of working conditions and product quality, respectively.

Our project builds on and contributes to this literature with empirical research that examines the relationship between working conditions and product quality in the export oriented, handmade carpet industry in India, Nepal, and Pakistan. The richness of our data and the measurability of differences in products across space allow us to further examine the underlying

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<sup>21</sup> Abowd, Kramarz, and Moreau (1996) find only weak evidence of his hypothesis in France. Brown and Medoff (1989) find little support for the hypothesis that the positive relationship between employer size and wages is due to larger employers offering inferior working conditions.

<sup>22</sup> Kugler and Verhoogen (2012) use unit values to proxy for product quality. Khandelwal (2010), who uses a more direct measure of product quality, also finds that more R&D intensive industries tend to have higher scope for quality differentiation of products.

<sup>23</sup> For example, a case study of two Nike suppliers in Mexico by Locke et. al. (2007) finds that workers in factories with better working conditions (measured as higher pay, adherence to work hour regulations, and worker participation in decision making) produced higher quality product. Ichniowski et. al. (1996) find increases in product quality and productivity of workers in a GMs automobile assembly plant that implemented "innovative management practices" that emphasized training, re-organization into teams, a single wage rate for unskilled hourly workers, and better communication between workers, management, and union leaders. Jayawardana and O'Donnell (2009) find increases in product quality and worker productivity and declines in worker absenteeism and turnover in a garment factory in Sri Lanka that increased participation of workers in supervision among production line operators. The study also noted increased peer pressure and increased expectations on worker performance.

relationships between working conditions and product quality. We should note that the relationships found in our work should not be interpreted as causal. However, while we, like all existing literature, do not have a source of truly random variation in working conditions, we can directly measure quality and workplace characteristics and control for far more reasons for a spurious correlation between product quality and workplace conditions than is possible in the existing literature. When we do so, we find little to suggest a link between product quality and working conditions. We discuss this data next.

### **3. Data**

This study uses the Carpet Labor Demand Establishment Panel (CLDEP) that was collected as part of the project by U.S. Department of Labor Office of Child Labor, Forced Labor, and Human Trafficking's *Research on Children Working in the Carpet Industry of India, Nepal, and Pakistan* (Cooperative Agreement Number IL-16565-07-75-K with ICF Macro, hereafter "the Carpet Study").

This data provides a detailed longitudinal survey of establishments involved in the export of handmade carpets in India, Nepal and Pakistan. CLDEP consists of 3 rounds of survey data collected between April 2010 and July 2011 in all 3 countries.<sup>24</sup> Table 1 describes the timing of each survey round in each of the three countries. There is substantial overlap in the dates of rounds 1 and 2 across all 3 countries. Round 3 in Nepal was delayed relative to the other two countries. Our empirical approach below controls for differences in the timing of survey rounds across the three countries.

The goal of sampling for CLDEP was to produce a representative sample of establishments in handmade export-oriented carpet-manufacturing sector in each country. The

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<sup>24</sup> The Carpet Study was completed in May 2012. Edmonds received authorization from Charita Castro, Director of Research at OCFT, for the use of CLDEP in this study for ILAB. CLDEP was to become publicly available at the conclusion of the Carpet Study although release is still pending at the time of writing.

frame used to draw CLDEP establishments was collected as a part of the Carpet Study. The Prevalence and Conditions Survey, the PC Survey, was a nationally representative cross-sectional survey of the carpet study in each country. The development of the frame for the PC Survey was conducted separately in each country by compiling export licenses, interviewing exporters, working with carpet export promotion organizations, and NGO partners. Two separate strata were developed in each country. The factory stratum contained a list of registered factories, and the household stratum contained a list of communities where production was known to take place. The PC Survey treated each stratum separately with a simple random sample from the factory stratum and sampling proportional to the size of manufacturing for the community stratum. Within sampled communities from the household stratum, enumerators conducted a census that listed all establishments (factory or household) involved in export carpet manufacture. It is straightforward to identify whether the carpet is potentially exported as the quality, design, and materials are different than carpets bound for domestic markets. From the community census, 5 establishments from each community were drawn at random for the detailed PC survey. The sampling frame in India omitted factories that subcontract from exporters but that do not export themselves and are not located in communities that fall under the community frame. We do not expect this to be an obvious source of bias in the present study.

CLDEP is a simple random sample of establishments interviewed in the PC survey. For sampling for CLDEP, the simple random sample was conducted separately within each stratum. In CLDEP, we use the word “establishment” to refer to both household and formal factory manufactures.

Table 2 describes the sample from each country and each round. The target number of establishments was 175 in each country, although Pakistan wound up with 174 establishments in

round 1 and 172 in rounds 2 and 3. In India, 3 establishments interviewed in round 1 could not be located in round 2. No additional attrition occurred between rounds 2 and 3. In Nepal, 6 establishments from round 1 were located but found to be closed by the time of round 2. 3 establishments closed between rounds 2 and 3 in Nepal. In Pakistan, 40 round 1 establishments could not be located for round 2. There were extensive floods in Pakistan between round 1 and round 2 that resulted in displacement of the population. 10 establishments in round 2 in Pakistan were unable to be located in round 3. For all three countries, extensive contact information, references, and GIS data were collected. Hence, we feel that enumerator error is unlikely to be a reason for attrition.

Attrition was handled differently in Nepal compared to Pakistan and India. CLDEP expected higher rates of attrition in Nepal than observed, so it put in place a different way to deal with attrition in Nepal. In order to keep track of changes within the industry, CLDEP conducted a census of carpet-weaving establishments during each round of data collection in the wards that were sampled in Nepal. Within each sampled location, CLDEP collected a complete list of carpet-weaving establishments and replacement establishments were drawn from this list using simple random sampling. Thus, the Nepal sample maintains its representativeness (albeit of initially sampled communities) over time. In India and Pakistan, replacement establishments were drawn from the original PC Survey. Hence, the CLDEP data for India and Pakistan are a representative snapshot of how the establishments in the industry at the time of the PC Survey (2009 for those countries) changed over time.

CLDEP data collection had 5 components that will be used in the current study. First, there is a fairly standard enterprise survey with information on revenue, expenditures, productive capacity, and input prices. This survey was field tested and adapted for details specific to the

carpet sector. Second, there is an extremely detailed survey on the most recently produced carpet by the establishment. CLDEP measures its price, knot quality, raw material inputs, designs, prices, and contract terms. This “Most Recent Carpet” survey is critical in what we do below. Third, there is a worker survey that collects data on demographic characteristics, experience, labor supply, self-reported productivity, and information on the worker – employer relationship. Fourth, there is an enumerator compiled site survey that contains observations about the workspace. Fifth, there is a detailed community survey for each of the sampled communities in each of the countries with information on local community characteristics and important events. We end up with a minimum of 35 communities in each country and round (more communities are included when sampled factories from the factory stratum come from communities missed in the community frame). All five parts of CLDEP were conducted in each of the 3 rounds with minor changes in questionnaires.

#### **4. Assessing different measures of product quality and workplace characteristics**

As discussed above, the focus on carpet industry enables us to make several important contributions to the existing work on the topic of working conditions and product quality. First, concepts like "product quality" and "work conditions" are multidimensional, difficult to define, and often not directly measured in standard firm datasets. We have access to an unusually detailed data on firms and products in the carpet industry that enables us codify and define these concepts in several ways. Our first goal is to assess the strengths and shortcomings of this product quality and working conditions data. We begin by describing the working conditions in the carpet industry. We then examine the relationship between different measures of product quality.

The two sub-parts of this section are organized in similar ways. First, we describe the measures available in CLDEP. Second, we compute pairwise correlations for the different measures of product quality and workplace characteristics (separately). A correlation is a measure of relationship between two or more variables. We report Pearson correlations that report the extent to which variables are proportional (that is, linearly related) to each other. Correlations range between 0 and 1 in absolute value, with a correlation of 1 or -1 suggesting perfect co-linearity. The square of the correlation is equivalent to the R<sup>2</sup> of a regression of one variable on another. We do not report the significance of these correlations because of the large volume of correlations reported and because our primary interest in the study is on the relationship between working conditions and product quality (where we report test statistics).

#### **4.1 Working Conditions**

Working conditions can mean many different things, and we are interested in the interrelationship between various working conditions measures in CLDEP. CLDEP was not designed to measure working conditions in ways that can perfectly map to ILO core labor standards. We have sufficient proxy measures to organize our discussion of CLDEP working condition measures around the ILO core labor standards and measures of acceptable conditions of work with regard to (minimum) wage, hours of work, and occupational safety and health.

Table 3 contains the measured working conditions variables that are the focus of this study, organized by their relationship to ILO core labor standards and acceptable conditions of work. We should have complete records for all 1568 establishment \* round observations (see Table 2), but in practice we are missing some data because of enumerator errors. For example, we are missing unit wages for 8 establishments that did not have paid employees. The enumerator failed to record in-kind expenditures for those establishments or to collect worker

data for other workers in those establishments. We are missing data on the worksite for 18 establishment-round observations in Pakistan and data on the physical area of the workspace for an additional establishment (that is in the survey for 2 rounds). All nominal values have been converted to U.S. dollars using the exchange rate contemporaneous with the survey (Table 6). In describing the data, we do not weight the data by the inverse sampling probability, because this puts a large weight on the Indian data where each sampled establishment represents more than ten times the number of establishments than each sampled Nepali establishment does.

The effective elimination of child labor is a core labor standard<sup>25</sup>, and the employment of children in the carpet sector is considered a worst form of child labor in many countries.<sup>26</sup> We rely on two different measures of the presence of child labor in the establishment. First, the enumerator counted how many workers present appeared to be children. Establishments averaged 1.3 workers that appeared to be children out of an average of 10.6 workers. Second, the establishment manager reported the ages of workers. 0.3 workers were reported under 15 per factory with a maximum of 33. While these numbers differ, they are not necessarily inconsistent as enumerators were asked to count how many workers appeared to be under 18. There is bound to be error in enumerator judgment of apparent ages, and the probability of employment increases with age (in general and in the carpet industry). In Table 4, we report pairwise correlations for each of the workplace characteristics measures. The correlation between these

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<sup>25</sup>See ILO Conventions C. 138 and C. 182.

<sup>26</sup> In India, the 1986 Child Labor Prohibition and Regulation Act prohibited the employment of children under 14 in hazardous occupations. Carpet-weaving, hand-loom, and wool-processing were listed as hazardous activities. The Juvenile Justice Act of 2000 made hiring a child below 18 in a hazardous activity illegal. In Nepal, the 2007 Constitution prohibited the employment of persons under 18 in hazardous work. The 1999 Child Labor Act listed carpet weaving, dyeing, and wool cleaning as hazardous work. In Pakistan, the 1991 Employment of Children Act prohibited the employment of children under 14 in hazardous occupations. Carpet-weaving, wool cleaning, and the wool industry were listed as hazardous occupations and processes.



two child labor measures is positive and strong: 0.70. Approximately half of the variation in each child labor related measure can be accounted for by the other.

The elimination of all forms of coerced and forced labor is a core labor standard.<sup>27</sup> It is difficult to identify coerced and forced labor in a quantitative survey. We have three markers of vulnerability to forced labor in Table 3: the presence of unpaid workers owing a debt to the owner or manager; the presence of any workers who owe a debt to the owner/manager; and the presence of any unpaid workers in the establishment who are not related to the owner. All of these rely on manager reports as to whether workers are paid or owe a debt. Hence, these measures will miss instances of forced labor that are known to be criminal by the manager. We opt to use indicators of the presence of any of these arrangements rather than counts of the number of workers with these arrangements, because most of the variation in the data is between 0 and 1 for the two measures that include unpaid workers. 21 percent of establishments have at least 1 worker owing the manager or owner a debt. 3 percent of establishments report having workers that owe a debt and are unpaid. 1 percent of establishments have workers that are unpaid and unrelated to the owner. Many of the unpaid workers that owe a debt are family members. These different measures of vulnerability to forced labor are surprisingly weakly correlated in Table 4. The correlation coefficient is -0.2 between the presence of workers owing a debt and unpaid, unrelated workers.

The elimination of discrimination with respect to employment and occupation is a core labor standard.<sup>28</sup> We do not have any obvious measures of the presence of discrimination in CLDEP. The most related attribute available in the data is the manager's report on whether an establishment was visited by a government labor inspector. 4 percent of establishments report

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<sup>27</sup> See ILO Conventions C. 29 and C. 105.

<sup>28</sup> See ILO Conventions C. 100 and C.111.

the visit of a labor inspector in the last 12 months. These labor inspectors may engage in a wide range of activities, but the treatment of disadvantaged groups has been a substantive issue in all three countries studied.

Freedom of association and the right to bargain collectively is another core labor standard that is poorly measured in CLDEP.<sup>29</sup> We can identify whether a union representative has visited the establishment, and we take this as a proxy for freedom of association and the right to bargain collectively, although it is obvious why that assumption may be incorrect. 15 percent of surveyed establishments report being visited by a union representative.

Table 4 also reports pairwise correlations of working conditions across the above broad groupings. The labor inspector and union representative visits are positively correlated in Table 4. 13 percent of the variation in union representative visits can be explained by labor inspector visits. Several additional associations stand out. The child labor measures are correlated with the labor and union variables in different ways. The child labor measure based on enumerator assessment is positively correlated with labor and union presence. The measure based on manager assessment is negatively correlated. One explanation for this difference is that the presence of younger workers (in the manager assessment) may be correlated with remoteness which makes union and labor visits less likely whereas the presence of the older youth included in the enumerator assessment may be correlated with establishment size. It is important to remember that correlation is not causation.

Similarly, the forced labor measures relate to the labor and union variables differently. Both of the variables involving unpaid labor are negatively correlated with labor inspectors or

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<sup>29</sup>See ILO Conventions C. 87 and C. 98.

union representative visits. The presence of a debt is positively correlated with each (which again may be capturing establishment size).

The most common workplace characteristics used in the existing literature are unit wages and hours worked. They are also of clear interest to U.S. policymakers who included "acceptable conditions of work with respect to minimum wages, hours of work, and occupational safety and health" among 'internationally recognized worker rights' in US trade law.<sup>30</sup> Our data allow us to proxy these measures with information on unit wages, timing of payment, weekly hours and work environment.

For the wage category, we consider unit wages and whether there are workers in the establishment paid only after carpet completion. We compute unit wages by dividing the manager reported total labor bill for the 30 days prior to the survey by the total number of workers (production and non-production). There were two clear outliers in the data that have been excluded from our analysis. On average, a worker earns \$27 per 30-day period. In-kind transfers are difficult to value, and we expect considerable measurement error. \$27 per worker per 30-day period is below the level of compensation we expected to see.

The frequency with which workers are paid is a contentious issue among the international labor rights community and in the carpet sector in particular. Consistency of the weave is important to the value of hand woven carpets, and managers want to use the same worker until a carpet is complete. However, making payment conditional on the completion of a project can also leave the worker vulnerable to exploitation. Half of all establishments report having workers that are only paid upon completion of the carpet.

These two measures of the circumstances of compensation are negatively correlated (Table 4). Establishments with higher wages are less likely to pay workers only when carpets

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<sup>30</sup>See US Trade Act of 2002.

are complete. Higher wages are negatively correlated with both child labor measures and workers owing a debt. They are positively correlated with visits from labor inspectors. Workers being paid at the end of a project are positively correlated with workers owing the manager a debt and with visits from a union representative.

After wages, the most common measure of workplace characteristics is hours worked. Hours worked are an average across all workers in the worker survey. This includes both production and non-production workers, paid and unpaid. The recall period for the hours worked question is 7 days prior to the survey interview. Workers report working on average 40 hours per week with a maximum of 84 hours (Table 3). The minimum of 0 workers reflects some establishments that produce carpets, but are not doing so at the time of the interview (they were included in the sample).

Unit wages and hours worked are positively correlated, but the correlation coefficient is 0.135. Unit wages can explain 2 percent of the variation in hours worked. Compared to wages, hours worked is more strongly correlated with workers who appear to be children, labor inspector visits, union representative visits, and the some of the environmental hazard measures discussed below. The correlation between hours worked and unit wages is lower than we expected, and implies that there may not be a strong relationship between the two most common workplace characteristics that are often separately used in the literature.

A great deal of policy attention has been directed towards the physical work environment in recent years, and we compute four measures of the physical work environment from CLDEP. All countries have some occupational health and safety infrastructure relevant to carpets, and 4 percent of establishments report a visit in the last 12 months (Table 3). Environmental hazards include the presence of toxic chemicals (chemicals used in dyeing wool being the most

prevalent), excessive noise, bad odors, visible particulates in the air, and noxious smells. 32 percent of establishments have some evidence of environmental hazards present. Physical space for work is an important dimension of physical safety, and establishments average 0.08 workers per square foot. The availability of drinking water is important to worker welfare and 88 percent of establishments have water available on site.

These measures of the physical environment are meant to capture different dimensions of the physical workspace, and their correlations in Table 4 suggest that they are distinct attributes. Health and safety inspector visits are positively correlated with workers per square foot and the availability of water and are negatively correlated with visible environmental hazards. Worker density and water are positively correlated with each other and negatively correlated with visible environmental hazards as well. Overall, the largest correlation among these worksite variables is the -0.22 correlation between visible environmental hazards and water on site. This implies that 5 percent of the variation in hazards can be associated with water access.

The correlations between these worksite variables and other labor standards are interesting. The correlation coefficient between workers appearing children and worker density is 0.255. Both child labor measures are negatively correlated with visible environmental hazards. Visible environmental hazards are also negatively correlated with labor inspectors and union representatives whereas worker density is positively correlated with both these characteristics.

The list of working conditions that we focus on in this study captures different aspects of working conditions. This set of working conditions is a subset of the working condition measures feasible in CLDEP. We choose these measures to most closely approximate different aspects of the ILO core labor standards and acceptable working conditions, but the exact choice

of working conditions measures to focus on is somewhat arbitrary. Other workplace characteristics (summarized in the appendix) are used to control for differences between establishments when looking at the relationship between working conditions (listed in Table 3) and product quality in section 5.

Overall, the access to an unusually detailed data on firms in the carpet industry that enables us to examine the relationship between a large set of working conditions in Table 4. The main conclusion from this analysis is that, with the exception of the two child labor measures, the correlations in Table 4 are small. This highlights that there are many different aspects of working conditions, and the information captured in the two most prevalent measures of the workplace conditions used in the existing literature summarized in section 2 (hours and wages) is only a limited part of the working environment.

## **4.2 Product Quality**

There are fewer measures of product quality in CLDEP compared to workplace characteristics, but our measures of product quality are considerably more detailed than is typical in the literature summarized in section 2. Table 5 provides summary statistics on the product quality measures available in the data.

The unit price is the most common product quality measure in the existing literature. We compute the unit price as the ratio of revenue in the 30 days prior to the survey divided by the number of carpets sold in the 30 days prior to the survey. It is missing for establishments that have not sold carpets in the previous 30 days. This selection is intrinsic to unit price measures of product quality. Unit prices are only available when a product's quality is high enough to generate sufficient demand and a sale over the reference period. Our most recent carpet survey does not restrict the time period in which the most recently completed carpet was manufactured.

All nominal values have been converted to U.S. Dollars using the exchange rates reported in Table 6. The average unit price is \$245 with considerable variation. The upper end of the unit price distribution is implausible from our perspective, but for that observation, the data are internally consistent.

The most recently completed carpet survey provides the richest source of data on product quality. We know its price, its weight, its type, and its knot density (for hand knotted rugs). The average price for the most recently completed carpet is \$377 (with a profit of \$159 on the carpet). Weight is an important attribute of carpet quality, and the average carpet weighs 53 pounds. The average weight and price are higher than anticipated because of two big, high priced, and heavy carpets in the dataset. The data are internally consistent on these observations (the really heavy rug is really big and expensive), so we treat them as data and not measurement error.

87 percent of most recently completed carpets are hand knotted. For hand knotted rugs, the density of knots is a quality measure (and an important determinant of how much wool gets used). The most recently completed hand knotted rug has 168 knots per square inch. The standards for measuring the density of knots on hand-knotted carpets differ in each of the three countries. In the knots per square inch row, we have transformed the country knot measures into a common unit, but we believe a substantive amount of the variation in knots reflects measurement issues and the transformations used to make different countries comparable. We are not confident in these transformations, so we have also standardized the knot density relative to each country \* round mean in the Table. This standardization preserves comparability of relatively low and high quality carpets within a given round\*country grouping and is not as

vulnerable to biases from errors in the transformation to make each country comparable. The standardized knot density is also reported in the Table.<sup>31</sup>

One of the problem with price as a measure of quality is that there are many attributes that impact the price. We compute an unexplained price as the component of price that cannot be explained by observable characteristics. The difference between the actual price of the most recently completed carpet and the unexplained price is the component of price that can be explained by observable characteristics which may themselves be components of quality.

To compute an unexplained price, we regress the natural log of the price of the most recently completed carpet on country\*round fixed effects, dummies for the types of characters and scenes depicted on the carpet, dummies for the manufacturing process, the log of the knot density, a dummy for whether the knot density of the carpet is reported, the log of the carpet weight, a dummy for whether the carpet weight is reported, and indicators for whether the carpet uses an establishment design, was sub-contracted from another establishment, and contains a social label. The unexplained price is the residual from this regression exponentiated to convert it back to dollars. By construction, it has a mean of 1 given that 0 is the natural log of 1. The unexplained price is then the dollar component of the price that cannot be explained by observable carpet characteristics. The standardized unexplained price standardizes the unexplained price relative to the country\*round mean and variance.<sup>32</sup>

Table 7 presents the pairwise correlations of the product quality measures defined in Table 5 (we omit the type of rug categories). Unit prices are positively correlated with other

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<sup>31</sup> In the regression work below, we do not consider the standardized knot density as an outcome, because we include round\*country fixed effects in all of the empirical work as discussed in the next section. With these controls, hypothesis tests on the standardized and non-standardized knot densities yield the same results. We include the standardized knot density in Table 5 and Table 7, because we are interested in comparing quality measures descriptively, free from bias from country\*round differences.

<sup>32</sup> As with the standardized knot density, we include standardized prices in our descriptive table but not our regression work.



product quality measures, but the correlations are not strong. For example, the correlation coefficient between unit prices and actual prices on the most recently completed carpet is .26, implying that 7 percent of the variation in unit prices can be explained by the actual price of the most recently completed carpet. Unit prices are positively correlated with weight and knot density as well, but overall it is clear that the most common product quality measure in the literature captures little of the variation in product quality that we actually observe in the carpet data.

Interestingly, the actual price of the most recently completed carpet is not as strongly correlated with weight and knot density as we expected. There is a mechanical relationship to the residual price, but observable characteristics can only explain 17 percent of the variation in the actual price (thus the correlation coefficient of 0.91). We see this in the correlation coefficients between price and weight and knot density.

In summary, our study focused on several measures of product quality in a single industry rather than rely on a unit price as a proxy for product quality as commonly done in the existing work. The implication of analysis in Table 7 is that one needs to be cautious when using unit prices as a proxy for quality, as done in much of the existing literature. Unit prices bear a weak relationship to actual prices. Another implication of our analysis is that even when one focuses on an industry where quality is more easily defined (a handmade carpets), there are several different components of product quality. Knot density and weight are correlated with actual prices but not strongly (and the correlation between weight and unit prices is larger than weight and actual price). Knot density and weight themselves are negatively correlated. Heavier carpets often use a courser wool that can be knotted less finely. Overall, this suggests that

product quality is a multi-dimensional concept and that studies that simply rely on unit prices might potentially miss important dimensions of carpet quality.

## **5. The link between product quality and working condition: Empirical Methodology**

The direct measures of product quality and variety of working conditions measures enable us to directly and more convincingly answer questions of whether there is a link between working conditions and product quality. Our baseline empirical framework documents the association between the quality of carpet produced by an establishment and working conditions in the establishment. The baseline econometric specification is

$$\ln(\text{quality}_{ft}) = \alpha + \beta x_{ft} + \lambda_{ct} + \varepsilon_{ft} \quad (1)$$

where  $\text{quality}_{ft}$  denotes the quality of carpet produced by establishment  $f$  at time  $t$ ,  $x_{ft}$  is a measure of working conditions in establishment  $f$  at time  $t$ , and  $\lambda_{ct}$  is a country\*time fixed effect. The inclusion of  $\lambda_{ct}$  is important for some quality measures whose measurement differs between country and across survey rounds. The coefficient  $\beta$  on a measure of working condition is the main coefficient of interest.

We estimate (1) using the five distinct quality measures described in Table 5. Most large-scale existing studies proxy for product quality with product unit values (i.e. revenues/quantity sold). As discussed in section 2, while higher unit values might signal higher quality, unit values might also reflect market power and are not comparable across products measured in different units. We examine unit values as a measure of quality in estimating (1). Focusing on carpets alone is an improvement over the current literature using unit prices to proxy quality, but our unit prices face all the other typical criticism.

We also consider the actual price of the most recently completed carpet and the unexplained price of the most recently completed carpet (the residual price after controlling for

observable attributes) as measures of quality in estimating (1). These observed prices have important advantages over unit values but market conditions and factors unrelated to quality can influence them. We also consider two direct quality measures in carpet weight and knot density (knots for hand knotted carpets only) in estimating (1). These direct measures of product quality are unusual in the literature, and our discussion from the section 4.2 implies that they contain distinct information from prices.

We look at the relationship between each of these five product quality measures and every workplace characteristics described in Table 3. For each working condition and product quality measure, we estimate 5 regressions. First, we directly estimate (1). The inclusion of round\*country effects in (1) addresses idiosyncratic measurement issues and controls unobserved factors that affect differences in quality and working conditions across countries and over time. This specification most closely approximates what an observer in the field would observe about the relationship between a working condition and product quality. This is not a causal relationship as there are many omitted establishment-specific factors that influence both product quality and each working condition within a country at a point in time. We call estimates of (1), specification I in our results below.

We improve the comparability of establishments that differ in working conditions by including the vast array of controls available in CLDEP and described in the appendix. We have controls that account for differences between establishments in market conditions, input prices, manager characteristics, local industry structure, supplier relationships, capital availability, and other establishment attributes. We then modify (1) as:

$$\ln(\text{quality}_{jt}) = \alpha + \beta x_{jt} + \lambda_{ct} + h(\delta_j, \gamma_{jt}) + \varepsilon_{jt} \quad (2)$$

where  $h(\delta_f, \gamma_{ft})$  is the vector of establishment  $\delta_f$  and establishment\*time varying  $\gamma_{ft}$  attributes that are correlated with the working condition measure  $x$ . This is labeled as specification II in the results below.<sup>33</sup>

Because we have repeated observations on the same establishments, it is possible to control for time-invariant establishment attributes more flexibly than in specification II by including establishment fixed effects. Specification III adds establishment fixed effects to equation (2):

$$\ln(\text{quality}_{ft}) = \alpha + \beta x_{ft} + \lambda_{ct} + h(\gamma_{ft}) + \pi_f + \varepsilon_{ft} \quad (3)$$

where  $\pi_f$  is the establishment fixed effect, and the control function  $h(-)$  only includes time varying establishment characteristics from the appendix. We prefer specification II to specification III because the coefficient  $\beta$  in equation (3) is identified only from establishments that change their working conditions over the 18-month period of study. This period of time is potentially too short to capture meaningful changes in working conditions, and most of the observed variation in working conditions over time within an establishment might reflect measurement error.

We also examine heterogeneity in the association between working conditions and product quality by establishment type (i.e. household-based, factory) and country. We do not have a strong theoretical case for why we should expect heterogeneity in the association between working conditions and product quality. That said, one can think of scenarios that would lead to heterogeneity along these dimensions. For example, factories may have more incentives to adjust working conditions to attract better workers if household-based establishment labor is less

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<sup>33</sup> We considered less parametric approaches to controlling for observable differences associated with establishments, including reweighting the data to improve the comparability of establishments that differ in each working condition. In the end, this reweighting did not alter our basic findings here of little relationship between product quality and work place conditions.

elastic. Alternatively, there may be different correlations that have nothing to do with causal relationships. For example, factories may produce better carpets and have better conditions on average, because factories think more about the location and flow of production compared to a home-based establishment.

To examine heterogeneity, we modify specification II. For establishment type, we modify (2) as:

$$\ln(\text{quality}_{f_t}) = \alpha + b_1 x_{f_t} + b_2 x_{f_t} * \text{Fact}_f + \lambda_{ct} + h(\delta_f, \gamma_{f_t}) + \varepsilon_{f_t} \quad (4)$$

where  $\text{Fact}_f$  is a dummy that is one if establishment  $f$  is a factory and this indicator is also included in the control function  $h(-)$ .  $b_1$  is the percentage change in product quality with a change in the working condition for household based establishments.  $b_1 + b_2$  is percentage change in product quality with a change in the working condition for factories.  $b_2$  is the percentage change in product quality with the working condition that differs for factories compared to household based establishments. Tests of the null hypothesis that  $b_2 = 0$  are tests of the null that there is no difference in how product quality relates to working conditions by establishment type.

For country heterogeneity, we modify (2) as:

$$\ln(\text{quality}_{f_t}) = \alpha + B_1 x_{f_t} + B_2 x_{f_t} * \text{Nepal}_f + B_3 x_{f_t} * \text{Pak}_f + \lambda_{ct} + h(\delta_f, \gamma_{f_t}) + \varepsilon_{f_t} \quad (5)$$

where  $\text{Nepal}_f$  is an indicator that is 1 if establishment  $f$  is in Nepal and  $\text{Pak}_f$  is an indicator that is 1 if the establishment is in Pakistan. The level effects of differences in product quality between countries are captured by the country\*round dummies  $\lambda_{ct}$ .  $B_1$  is the percentage change in quality with a change in working condition in India.  $B_1 + B_2$  is the percentage change in quality associated with a working condition change in Nepal. The null hypothesis  $B_2 = 0$  is the hypothesis that the relationship between quality and working condition does not differ between

Nepal and India.  $B_1 + B_3$  is the percentage change in quality associated with a change in the working condition in Pakistan. The null  $B_3 = 0$  is the null for the hypothesis that the relationship between product quality and working conditions is the same in Pakistan and India. The difference between the product quality – working condition relationship for Nepal and Pakistan is  $B_2 - B_3$  and test statistics are not reported for the null that this difference is 0. We choose India as the reference country, because it is the largest carpet producer among the three countries.

This empirical approach involves estimating 25 regressions for each of the working condition measures listed in Table 3.

## **6. Main Findings**

This section discusses the results of estimating the five empirical specifications from the previous section for each of the 14 working conditions in Table 3 as an independent variable and the five product quality measures from Table 5 as outcomes. The specific results for each working condition measure are described in subsections below.

Prior to discussing these specific results, we highlight findings that are common across most specifications. First, we typically find that variation in a working condition is associated with variation in product quality. Most results suggest that better working conditions are associated with higher product quality. This is consistent with the findings in the existing literature summarized in section 2, which usually relies on one measure of product quality and limited number of working conditions. Interestingly, we also find that the relationship between working conditions and product quality is not usually consistent across *all* product quality measures. The unexplained price (residual variation in price after controlling for observable product attributes) often differs from the other product quality measures. Second, the statistical

associations between product quality and working conditions disappear in most cases when we control for observable differences in establishment attributes. This is an important finding as it suggests that one needs to be cautious about interpreting the relationship between working conditions and product quality as causal. Finally, there is no theoretical reason why the relationship between product quality and work characteristics should vary by establishment type or country, and we rarely find substantive differences between establishment types or countries. We further discuss these broader findings and their implications for policy and future research in conclusion, after the discussion of more specific findings below.

## **6.1 Child Labor Related Measures**

Establishments that use more child labor produce higher quality products as measured by most quality measures. However, this relationship appears spurious. We find that this positive association disappears when we control for other establishment characteristics.

Table 8 contains findings from estimating equations (1)-(5) for each of the 5 product quality measures for the “number of workers who appear to be children” working condition measure. The column heading indicates the product quality measure used as a dependent variable. Rows report different estimation specifications. Thus, each cell reports the coefficient  $\beta$  (and standard error) associated with a specification reported in the respective row using a product quality measure reported in the respective column.

The first row contains estimates of (1) that only control for country\*round differences. We observe that adding an additional worker who appears to be a child raises unit prices by 5 percent, actual prices by 6 percent, carpet weight by 4 percent, and knot density by 1 percent. Similar findings, slightly smaller in magnitude, are in Table 9 using the number of workers

below 15 reported by the manager as a dependent variable. These observations are consistent with the assertion that children make better carpets.

However, this positive association between child labor in the workplace and product quality primarily reflects establishment characteristics that also affect child labor and product quality. This is hinted at in the findings for the unexplained price where we see a negative correlation between product quality and child labor. Row 2 of each Table reports the findings from specification II that controls for observable establishment attributes. The magnitude of the working condition – product quality relation declines for all of the child labor related working condition measures. We still observe a statistically significant positive relationship between knot density and the presence of child labor. Row 3 contains findings from specification III that include establishment fixed effects. This specification eliminates any association between product quality and child labor. However, as we discussed in section 5, the results from specification III likely reflect measurement error in working conditions, and we thus use specification II as our preferred specification.

The finding that knot density is greater when more child labor is involved holds for household-based and factory establishments. The second panel in Table 8 contains estimates from equation (4). In general, in both Table 8 and 9, we cannot reject the null that the product quality – child labor relationship is the same in factories and household-based establishments. There are two exceptions for the child labor working condition measure based on enumerator observation. We observe that child labor is associated with heavier carpets in households. We find that the unexplained price is negatively associated with child labor in households.

Country differences are not statistically significant in general. The bottom panel of Table 8 contains estimates from equation (5). None of the country differences are statistically



significant in Table 8, with the exception of the findings based on the manager reported child labor measure in Table 9. Specifically, we observe that additional workers under 15 are associated with reduced knot density in India but not Nepal or Pakistan. The finding that child laborers are associated with greater knot density is driven by Pakistan. We have no explanation for these differences across countries, but as discussed in section 3, we are concerned about comparisons across countries using the knot-density measure given country differences in how knots are counted. These differences should be absorbed by country\*round effects and so should not bias our findings, but we have no ready explanation for the different relationships between knot density and children under 15 observed in India and Pakistan but not in prices.<sup>34</sup>

## **6.2 Forced Labor Related Measures**

As indicated in Table 4, the three forced labor related measures of working conditions are not as strongly related to each other as our child labor measures. Consequently, we observe greater differences across results based on working conditions related to forced labor and product quality than we documented for child labor.

In our baseline specification (specification I), establishments with workers who are unpaid and owe a debt to the manager or owner appear to produce lower quality products. These findings are in Table 10. However, these results are not very robust. Controls for establishment and product differences reduce this association. This is apparent in specification I for the unexplained price variation and is evident throughout specification II, with the exception of findings for knot density in specification II that are significant at 10 percent. Specification III with establishment fixed effects reduces the knot-density – forced labor measure relationship to insignificant. We observe significant differences between household-based establishments and

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<sup>34</sup>Type I error is a possibility.

factories in the association between prices and the presence of workers who are unpaid and indebted. These price differences are largely in Pakistan.

Establishments with paid indebted workers appear to produce higher priced products. This finding is not robust to specification III. Household-based establishments drive this finding. However, differences between household-based establishments and factories are not statistically significant although they appear economically meaningful. Table 11 contains these results where the working condition measure is an indicator whether an establishment has paid indebted workers.

In Table 12, the working condition measure is the indicator for the presence of unpaid workers who are not related to the manager or owner. We find some evidence that the presence of unpaid, unrelated workers is associated with lower prices although the finding is only significant at 10 percent level in specification II and is not robust to specification III. We find no meaningful variation by establishment type. We also do not find meaningful or robust differences in the relationship across countries. For example, Nepal appears different from India for the unit price findings, but neither is significant on its own. As discussed in section 5, the country differences are difficult to interpret, especially in the absence of a hypothesis about why there should be country differences.

### **6.3 Discrimination Related Measure**

Table 13 reports our findings for visits from a government labor inspector. We observe that labor inspectors are in general associated with higher quality products, but this association is much weaker when we control for observable differences in characteristics across establishments.

We find pronounced differences between household and factory based establishments. While factories have no association between inspector visits and unexplained price, weight, or knot density, households have much stronger associations. In all three countries, it would be unusual to have government inspectors in household establishments, so we suspect that this result might be driven by the fact that labor inspectors might only visit certain types of households. We find little meaningful differences between countries in the association between inspector visits and product quality.

#### **6.4 Freedom of Association Related Measure**

The findings on the relationship between union visits and product quality are in Table 14. In general, product quality is higher in establishments that have been visited by a union official, but this association disappears when we control for establishment characteristics in specification II.

There is heterogeneity by establishment type and country in the relationship between union visits and unit prices. For households (but not factories), union visits are associated with higher unit prices. This finding is driven by Nepal and Pakistan more than India. Given that this association between prices and union visits does not hold for actual prices, we suspect that this relationship might reflect the relationship between revenue and union visits. Much like the discrimination results, we suspect we are observing selection in what types of households union officials visit or what causes union officials to visit a household.

#### **6.5 Acceptable Conditions of Work: Minimum Wage Measures**

The existing literature mostly focuses on wage measures for working conditions and unit prices for a measure of product quality. We examine this link in this subsection. We find that higher unit wages are associated with better product quality. This finding is consistent with the

existing literature, and we obtain it for both unit prices and actual prices. These results are in Table 15 where the working condition measure is the log unit wage. Interestingly, including controls in Specification II weakens the relationship between wages and prices although we continue to reject the null of no effect of unit wages on prices. We cannot reject this null in the establishment fixed effects specification III, but the coefficients continue to be positive.

However, household-based establishments drive the finding that higher wages are associated with higher prices. This suggests that our observation that higher wages are associated with higher prices is mechanical. Unit wages for a household establishment are apt to be a transformation of revenue, which depends on prices. For example, consider the extreme case of a household establishment with 1 worker that produces 1 carpet. The unit price is then the same as the MRC Price. How much does the 1 worker make from producing the carpet? He answers that he pays himself a transformation of revenue. Hence, in households there is potentially a mechanical relationship between unit prices, actual prices (MRC Price), and unit wages.

Paying workers by carpet completion is associated with lower priced carpets. These findings are in Table 16. The inclusion of establishment fixed effects has little substantive influence on this result. The relationship holds in factories and households and across all countries. It is simple to think of explanations for this result that owe to selection in what leads an employer to only pay workers at completion, but the correlation is the extremely robust.

## **6.6 Acceptable Conditions of Work: Hours Measure**

Another commonly based measure of working conditions in existing literature is hours worked. Existing studies usually find that workers that work more hours (or excessive hours) produce lower quality products. Our findings for hours worked are reported in 17. We observe

higher quality products in establishments where workers work more hours. However, these differences dissipate when we control for observable establishment characteristics that could independently influence hours worked and product quality independently in specification II. Thus, there does not appear to be a robust relationship between hours worked and product quality in our data, especially once we control for confounding factors.<sup>35</sup>

## **6.7 Acceptable Conditions of Work: Occupational Health and Safety Measures**

The discussion of Table 4 in section 4 suggested that the four health and safety related measures are weakly correlated. It is thus not surprising that our findings on the association between health and safety related working conditions and product quality vary across measures.

Table 18 contains our findings on the association between visits by a health and safety official and product quality. Health and safety visits are associated with better quality, but not once we control for observable establishment characteristics in specification II. The sign of the coefficient flips once we control for observables in the unexplained price specification. This negative association between the unexplained price variation and health and safety visits appears concentrated in household establishments and in India. We also observe that health and safety visits are associated with greater knot density in India and in households. They are also associated with carpet weight in households. We are unclear how to interpret these different results across quality measures for households and India. However, occupational health and safety inspector visits are apt to be unusual in households. We suspect that there may be important omitted variables that determine why health and safety inspectors visit households that affect the interpretation of these findings.

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<sup>35</sup> This finding of little relationship between hours worked and any product quality measure conditional on establishment characteristics is not sensitive to functional form assumptions on how hours worked impacts product quality. We experimented with a partially linear specification using a Fourier series in hours worked. We did not learn anything from this complication, and we have opted to keep the treatment of hours consistent with other working condition measures.

Table 19 contains our results for the association between environmental hazards and product quality. We do not see robust evidence that there is a connection. Unexplained prices are higher in factories with environmental hazards present, but otherwise, we cannot reject the null of no relationship between environmental hazards and product quality.

Unit prices are higher in households with greater worker density, but this finding is not statistically significant for actual prices. Findings on the association between product quality and worker density (measured as workers per square foot) are in Table 20. For all of our control function results in the top panel other than specification II for unit prices, we observe standard errors that are large relative to the coefficients. This is consistent with a weak, highly variable association between worker density and product quality.

Water availability is associated with higher product quality, but not when we control for observable differences between establishments. Findings on the link between water access and product quality are in Table 21. In specification II, we observe that water availability is negatively associated with knot density. This association is driven by household based establishments and India and Pakistan. We do not have a theory as to why lacking water access would produce tighter knots.<sup>36</sup>

## **7. Conclusion**

This study considers the relationship between product quality and working conditions. The most prevalent measure of product quality in the existing literature is the unit price: total revenue divided by total sales. By using a unique dataset from the handmade carpet industry, we observe four alternative measures of carpet quality that rely on the direct measurement of observable carpet characteristics: carpet price, weight, type, and knot density (for hand knotted carpets). While we find positive correlations between the four direct measures of product

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<sup>36</sup>This may be a case of Type I statistical errors or omitted variables correlated with water access.

quality, the correlations between unit prices and direct measures of carpet quality are not strong. For example, 93 percent of the variation in actual carpet prices cannot be accounted for by unit prices. When we adjust for observable carpet attributes, unit prices can account for less than half a percent of the variation in the price.

The most frequently used measure of working conditions in the existing literature is the unit wage (total labor bill divided by the number of workers). Our data allows us to consider a wider array of working conditions. In particular, we focus on the unit wage and 13 aspects of working conditions that are directly measurable in our data. These working condition measures are related to the ILO's core labor standards and acceptable conditions of work. While wages are an important part of working conditions, we observe a weak correlation across the different aspects of working conditions examined in this study.

Taken together, our findings on the measurement working conditions and product quality yield several implications for the literature on the relationship between product quality and working conditions. First, our findings imply that the existing literature cannot generalize its findings based on one working condition measure to working conditions and core labor standards in general. Likewise, our findings illustrate that product quality is multi-dimensional. Consequently, findings on how a working condition impacts one aspect of product quality may not generalize to other aspects of product quality. In addition, our findings raise concerns about using unit prices as an informative measure of product quality, at least in the carpet industry. There are two reasons for our concern. First, unit price is not strongly correlated with more direct measures of carpet quality, including actual carpet price. Second, unit prices are at times correlated with working conditions, while no such association exists between actual prices and working conditions. This suggests that unit prices do not simply measure product quality, but

also proxy for other correlated establishment characteristics that independently influence product quality and working conditions. This leads to spurious correlation between unit prices and working conditions.

Our findings on the association between product quality and working conditions are also informative for the literature and policy discussions on the existence of a virtuous cycle, where improving working conditions lead to improving product quality. In general, we find that higher product quality is associated with better working conditions for most of our measures of product quality and working conditions. This matches the frequent field observation that better product come from nicer working environments. However, once we control for observable differences in establishment attributes such as manager characteristics and local input prices, this positive relationship between higher product quality and better working conditions vanishes. This observation that most relationships between working conditions and product quality are driven by observable differences between establishments highlights why anecdotes from field observations should not be the basis for policy.

While we find little evidence of a robust association between product quality and working conditions, three of our more specific findings should be highlighted. Consistent with the current literature, we find that higher unit wages are associated with higher unit prices. This type of finding is the basis for much of the literature arguing that better working conditions improve product quality. Interestingly, in our case, where we also observe actual price on the most recently completed carpet, we do not find a statistically significant relationship between actual price of a carpet and unit wages. In fact, the positive relationship between unit wages and unit prices is found among household-based establishments and not factories. We suspect that we may be observing a mechanical relationship. Suppose most labor in household based



establishments is family labor and that family labor supply to carpet production is not perfectly elastic. The income that family workers receive from working in the household is a function of how much revenue the household makes. Hence, the unit wages are a transformation of revenue and the unit price is defined using revenue. This example highlights the potential for spurious correlation and suggests caution in basing policy on findings using unit prices.

The most robust evidence of an impact of a working condition on product quality in our study is also related to compensation. 58 percent of sampled establishments only pay workers at carpet completion. Labor advocates have opposed this form of compensation out of a belief that this form of compensation gives considerable power to owners. We find that paying workers at carpet completion is associated with lower actual carpet prices in all countries and establishment types. We cannot say whether the association we observe is causal. Perhaps establishments only pay workers at carpet completion when carpet prices are low. Nevertheless, the correlation between low prices and paying workers at carpet completion is clear and robust. No other findings of a link between product quality and a working condition are as robust to different specification checks.

We observe a few instances where worse working conditions are associated with higher quality. In Pakistan, we find that more child labor is associated with carpets that have a greater knot density. This seems consistent with the idea that children have an advantage in knotting carpets although we do not observe this pattern in other countries and the greater knot density does not seem to translate to higher prices with more child labor. Also in Pakistan, we find that one proxy for forced labor (unpaid workers owing debt to the establishment manager) is associated with higher carpet prices in factories. We would expect forced labor to lead to lower quality. Hence, we are suspicious that this finding may be spurious, especially given that this

proxy for forced labor is not associated with greater weight or knot density, two other important aspects of carpet quality. One possible explanation is that market power that allows one factory to fetch a higher price (without producing a better carpet) may also give the factory some power in the labor market.

Taken together, our results illustrate why policy should be cautious in relying on anecdotes and simple bivariate relationships. Product quality can mean many different things, even in the context of a specific good like hand-made, export-oriented carpets. Similarly working conditions are multi-dimensional. Not all dimensions of product quality and working conditions capture the same phenomena. But, overall, we find little to suggest a relationship between various aspects of product quality and working conditions that owes to anything more than spurious correlation. Unfortunately, sources of spurious correlation are not policy levers. Nothing in this study suggests that a policy focus on improving aspects of working conditions needs to consider anything about product quality.

The one possible exception to this finding of no meaningful link between product quality and working conditions comes from working conditions related to compensation. Improving compensation may improve worker effort. For example, workers might work better and harder in a job if they know that the welfare costs of losing the job are large. Alternatively, better compensation may attract more higher quality workers to a job. In this case, the welfare consequence of better compensation is unclear as policy might be concerned about the well-being of displaced, less productive workers, especially in a sector like carpet weaving where skills are not transferable to other occupations. Improving compensation is an important theme of core labor standards. The results of this study suggest that it might be useful to pursue field experiments that vary the structure and terms of compensation to examine a potential for a

virtuous circle where improvements in compensation are self-sustaining and lead to improvements in product quality or worker performance. Such studies would provide policy makers with better understanding of why and how employers and employees respond to changes in compensation. Understanding the impact of changing compensation should be a priority before policy pursues compensation increases as a goal of core labor standards.

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